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EFFECT OF FEEDING RABBIT DOES ON DIETS SUPPLEMENTED WITH HABARACHAD (*LEPIDIUM SATIVUM*) SEEDS ON PHYSIOLOGOCAL AND REPRODUCTIVE TRAITS AND ECONOMICAL EFFICIENCY

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ABSTRACT: The current design was conducted to investigate the impact of dietary Habarachad (HR) seeds as a dietary supplement on reproductive and economic performance of local rabbits in Egypt (Black Balady Rabbits). Rabbits were divided into four equal groups, each containing three female replicates and one male. The control group received commercial basal diet only, while the other groups received the basal diet supplemented with 2.5, 5, and 7.5 g/kg diet, respectively. The rabbits fed diets supplemented with both 5 and 7.5 g HR/kg diet recorded significantly the lowest feed intake than the control group. Litter size at birth significantly improved due to feeding on diet supplemented with 5 g HR/ kg diet followed by the diet contained 2.5 g HR/kg diet compared to the control diet. The kids from rabbits fed on diets supplemented with 5 g HR/kg diet had significantly the highest weight at birth and number at 21 day followed by the low level of HR as compared to the HR-untreated group. Litter size at weaning (35 day) was significantly increased by feeding on diet supplemented with 5 g HR/kg diet and the diet contained 2.5 g HR/kg diet came second followed compared to the control group. There was a significant improvement in feed conversion ratio due to feeding on diet supplemented with 2.5 and 5 g HR/kg diet compared to the control group. All different levels of HR had significantly higher value of serum globulin than the control group. Also, no significant alternations were detected in serum low density lipoprotein compared to HR-untreated group. On the other hand, it should be noted that both superoxide dismutase and total antioxidant capacity were significantly increased by feeding diets supplemented with 2.5, 5 and 7.5 g HR/kg diet especially level of 5 g/kg diet compared to the control group.

Conclusively, according to the results, it is concluded that dietary HR supplementation up to 5 g/ kg diet for Black Balady rabbit's does could be used to improve and maximize reproductive performance and economic efficiency.

Key words: Rabbits, *Lepidium sativum*, reproductive performance, Antioxidant status

INTRODUCTION

In Egypt, Due to rabbits' low-key nature, high fecundity, quick growth, and short gestation time (between 31 and 33 days), rabbit production is one of the initiatives that is expanding quickly (Mahrose *et al.,* 2010). Successful rabbit programmers that increase food security and revenue have been documented in poor nations like Egypt (Oseni and Lukefahr, 2014).In fact, there is an increased implication of feed additives where, health and reproductive efficiency in rabbits are enhanced by medicinal plants (Morshedy et al., 2022). Utilizing the medicinal plants improves the survival and development of the kits during nursing due to feeding on diets enriched with these supplementations (Pascual *et al.,* 2013).

Lepidium sativum L, often referred to as "Habarachad" locally, is a fast-growing annual plant that is native to West Asia and Egypt but is now grown all over the world. It is a member of the Brassicaceae family (Gokavi *et al.,* 2004; Doke and Guha, 2014). According to Deshmukh *et al.* (2017), Habarachad (HR) possesses exceptional nutritional and therapeutic benefits. The HR seed has a sizeable number of nutrients, including essential amino acids in protein (98% w/w) and remarkable amounts of leucine (8.21 g/100 g protein), phenylaniline, lysine, and glycine (Singh *et al.* 2015). In addition, the same author mentioned that some minerals such as calcium, magnesium, potassium, and phosphorus, the HR seed consider source to these minerals. Toxicology studies illustrated that HR seeds can be considered as non-toxic and safe (Patil *et al.,* 2015). HR seeds are a potential source of essential fatty acids and amino acids and minerals such as potassium, calcium and phosphorus. The seed also provides appreciable amount of health-protective bioactive compounds used to treat diabetes, hypercholesterolemia, bone fracture, constipation and some forms of cancer (Azene *et al.,* 2022).

In respect of phytochemical composition of HR seeds, saponins and flavonoids found in HR seeds are among the phytochemicals that are thought to be responsible for the plant's possible functional properties (Berehe and Boru 2014; Hunter et al. 2019). The collective phenolic and flavonoid content of the HR seed was calculated by Qusti *et al.* (2016) and was found to be 58.8 mg/100g and 42.35 mg/100g for both phenolic and favonoid. Sinapic acid and sinapin, as well as significant amounts of tocopherols, xanthones, tannins, anthraquinones, and anthocyanidins, are among the phenolic compounds present in HR seeds (Chatoui *et al.,* 2016). Additionally, it contains 582.23 g/100g of protocatechuic acid, 1460.80 g/100g of ellagic acid, and 3001.75 g/10g of gallic acid. Lepidine and semilepidine, two uncommon imidazole alkaloids, are found in garden cress seed (Mehmood *et al.,* 2011). As a result, they have antioxidant and health-promoting qualities, as well as depurative, aphrodisiac, ophthalmic, antiscorbutic, antihistaminic, diuretic, and carminative actions (Qusti *et al.,* 2016).

As a member of the super food family, HR seeds are significant for improving the medicinal and nutritional value of formulated and blended food items. Including vital fatty acids, amino acids, and minerals like iron, potassium, calcium, and phosphorus, HR seed is a potential source of both macro and micronutrients (Azene et al., 2022). The goal of the current study is to determine how the antioxidants in dietary Habarachad seed affect the productivity, serum biochemistry, and economic efficiency of local rabbits

MATERIAL AND METHODS

This study was conducted at the Rabbit Farm of the El-Serw Animal Production Research Station, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Egypt.

Experimental design:

Sixteen Black Balady rabbits (BBR) 10 months of age were randomly assigned to one of four dietary experimental groups of (3 ♀+1 ♂ each) that were conducted for 140 days (from April to the September 2021) to obtain on 3 births/doe and aim of males was mating. At the onset of the experiment, rabbits were weighed and assigned to 4 treatments based on body weight of does and average live BW was 3.197 kg/ female of rabbits.. Each group was represented in three replicates, where three does were individually housed in each replicate and fed their respective experimental diets (Table 1).

The first group was fed a commercial pelleted basal diet without any additives, whereas the second, third and fourth groups were fed basal diet supplemented with 2.5, 5 and 7.5 g HR/kg diet respectively according to the toxicology studies which reported that HR seeds can be considered as non-toxic and safe **(Patil *et al.*, 2015),** phytochemical composition of HR seeds and the previous studied on HR. All does were individually housed in wire galvanized battery cages (50 × 50 × 40 cm, length × width × height) in an open-side house under the same managerial and hygienic conditions. Cages were cleaned and disinfected regularly. Light in their houses was allowed 12–14 h daily during all experimental periods. Urine and feces dropped from the cages on the floor were cleaned daily in the morning. Each cage was provided with fresh water, and the experimental diets were offered ad libitum all over the experimental period.

The basal and experimental diets:

Table (1), calculated analysis of basal diet was determined according to feed composition tables for rabbits feedstuffs as proposed by Villamide *et al.* (2010) and De Blas and Wiseman (2010) and the requirements of digestible energy (DE Kcal/kg diet) and crude protein % were estimated according to FEDNA (2013).

Reproductive traits

During gestation and suckling periods:

Live body weight (LBW) was calculated in the beginning of study. The amount of feed consumed (FI) was calculated where FI= mount of feed offered – amount remained. Litter size as well as mean bunny weight was measured at birth, 21days and 35 days of age and thereafter daily weight gain (DWG) calculated for the periods from birth till 21 days, from 21 till 35 days and for collective period from birth till weaning (at 35 days) age. Viability rate as one of the sensitive parameters related to the economical return of production was also recorded at 21 days (from birth up to 21 days of age) and at 35 days (from birth up to 35 days of age). Feed conversion ratio (FCR) was estimated by the number of kilograms rations required for 1 kg body weight gain.

Blood Sampling and analysis:

At the end of the experiment, the same three rabbits used in the current study (n = 3) in each treatment were taken to collect blood samples. Fresh blood samples were collected from the rabbit's ear vein in without anticoagulant and kept at room temperature. The tubes were centrifuged at 3500 rpm for 20 min to separate the clear serum. The serum samples were kept in a freezer until serum biochemical analysis was carried out.

Serum biochemical parameters, which included Glucose (GLU) was assayed according to Henry, (1964). Total protein, albumin and globulin were determined using commercial kits according to Peters, (1968). Creatinine (CR) was determined according to Labbe *et al.*, (1996). Serum total cholesterol (TC) was assayed according to Tietz and Berger, (1976). Triglycerides were measured according to McGowan et al. (1983). High-density lipoprotein (HDL), low density lipoprotein (LDL), and very low density lipoprotein (vLDL) were measured according to Warnick and Wood, (1995). Aspartate aminotransferase (AST), alanine aminotransferase (ALT) were assayed according to Reitman and Frankel, (1957). Super oxide dismutase (SOD) was determined as indicator to the major system of antioxidant enzymes according to Beauchamp and Fridovieh, (1971) and Weydert and Cullen, (2010). Serum total antioxidant capacity (TAC) was assayed according to Koracevic *et al.* (2001).

Economic efficiency:

To evaluate the economic efficiency (EE) of using the experimental feed additives in does' rabbit diets, total feed consumption/dam and feed consumption for does with their litter were recorded. Total weight rabbits/dam, average of parity/dam, average of feed consumed (Kg/day) was estimated. The average weight rabbits/dam/parity used to calculate EE and REE depending on the market prices for both costs and return، during the whole experimental period. Economic Efficiency (E.E) was **calculated as follows:**

Total feed cost/dam (L.E) = Total feed intake (TFI, Kg x price/kg feed (L.E).Total return (TR)/dam (L.E) = Total weight rabbits/dam (kg) x price/kg live BW Net return (NR)/ dam (L.E) = Total return/dam (L.E) - Total feed cost/dam (L.EEconomic Efficiency (E.E) = Net return/dam (L.E) / Total feed cost/dam (L.E)

Statistical analysis:

Data were statistically analyzed using General Linear Models Procedure of the SPSS program (2008), a one way design was used; the following model was used to study the effect of different levels of Habarachad on parameters investigated as follows: The following model was used: $Y_{ij} = \mu + T_i + e_{iJ}$

Where: Y_{ij} = an observation, μ = overall mean, T_i = effect of treatment (i=1, 2, 3 and 4) and e_{iJ} = Random error

Differences means among treatments were subjected to Duncan´ s Multiple Range- test (Duncan, 1955).

RESULTS AND DISCUSSION

Productive performance:

Initial body weight (IBW) and feed intake (FI) of doe's rabbits due to feeding on different levels of Habarachad (HR) seeds are shown in Table (2). The results illustrated that the rabbits fed diets supplemented with both 5 and 7.5 g HR/kg diet recorded significantly (P≤0.05) lower value of FI than the control group and those fed the diet contained the low level of HR (2.5 d/kg diet).

In fact, feed additives such as HR improved the gastrointestinal tract and enable them to capture their genetic potential in productive performance. As shown in Table (3), the obtained data showed that LS at birth significantly (P≤0.05) improved as a result of feeding on diets supplemented with 5 g HR/ kg diet followed by the diet contained 2.5 g HR/kg diet compared to the control diet. In addition, regarding weight of kits at birth and number of kits at 21 day, the kits from rabbits fed on diets supplemented with 5 g HR/kg diet had significantly (P≤0.05) the highest values followed by the low level of HR as compared to the HR-untreated group or received high HR at level of 7.5 g/kg diet. However, no significant (P≥0.05) alternatives were detected in viability (%) at 21 day of age among the different experimental groups and control diet.

On the other hand, it was observed that the diet supplemented with 5 g HR/kg diet had significantly (P≤0.05) lower BW and weight gain at 21 day of age than untreated group. In this respect, the greatest values were obtained as a result of fed diet supplemented with 2.5 g HR/kg diet.

The most remarkable result is that LS at weaning (35 day) was significantly (P≤0.05) increased by feeding the doe rabbits on diet supplemented with 5 g HR/kg diet and the diet contained 2.5 g HR/kg diet came second followed compared to the control group. While, viability (%) at 35 day and weight gain of kits from 21 to 35 day were not significantly (P≥0.05) affected by the dietary treatments. The current data showed that the kits from rabbits fed diet supplemented with 2.5 g HR/kg diet significantly (P≤0.05) returned to occupy the first position with respect to weight at weaning and total weight gain as compared to the control group. Moreover, there was a significant (P≤0.05) improved in FCR due to feeding on diet supplemented with 2.5 and 5 g HR/kg diet compared to the HR-untreated group.

Regarding to results on the LS at birth, number of kits and FCR imply an important role for fed on diets supplemented with 2.5 and 5 g HR/kg diet. Phytochemicals in HR seeds seem to be the most likely explanations for this improvement where they enhance the reproductive hormones and antioxidant status (Abdella and Khalifah 2021). According to El-Salam *et al.* (2019), HR seeds have a high concentration of phenolic compounds (1572.4 g/100 g), including gallic acid (3001.75 g/100 g), ellagic acid (1460.80 g/100 g), and protocatechuic acid (582.23 g/100 g), which are thought to have a high antioxidant activity and be potential sources of functional food components (Sethiya et al. 2014). In HR seeds, the primary flavonoid, hesperidin (4934.99 g/100g), was quantified together with rutin (1216.72 g/100g), naringin (963.79 g/100g), and other flavonoid components, including quercetin, a potent antioxidant (El-Salam *et al.*, 2019).

Improvement in LS probably may due to properties of antioxidants present in the HR seeds whereas, the growth and dentify the organs of the embryo is associated with an accumulation of polyunsaturated fatty acids in tissue lipids (Speake *et al.*, 1998) making them susceptible to lipid peroxidation (Surai, 1999a). Duh and Yen (1997) mentioned that antioxidants compounds (phenolic) showed good hydrogen donating abilities and can react with reactive oxygen species (ROS) to convert them to more stable products and terminate radical chain reactions, indicating that they had effective activities as a radical scavengers. Thus, supplementation HR to the diet may be decreasing the oxidation products and enhancement the antioxidant system as shown in Table (5).

In addition, the probably reasons for this improvement in LS are speculative where, the hypothalamic-pituitary-gonadal axis activity was shown to be greatly elevated by the phytochemicals in HR seeds in a study by Asl *et al.* (2021), which increased serum luteinizing hormone (LH) and follicle-stimulating hormone (FSH) concentrations. Similar to the previous study, HR seeds increased the hormone levels of free testosterone, LH, FSH, progesterone, and oestrogen in does (Hekmatshoar *et al.*, 2021), which was attributed to the phytosterol (Victoria *et al.*, 2020) and phytoestrogen (Imade *et al.*, 2018). Also, in a study by El-Speiy *et al.*, (2021) on doe rabbit, HR oil increased the level of reproductive hormones, while improved antioxidant status and reproductive performance (conception rate and litter size).

From nutritional point, Mellor, (2000) stated that HR seeds can improve digestibility coefficient of nutrients. Lahiri and Rani (2020) mentioned that HR seeds contain lysine and methionine (6.26 gm/kg) where methionine aids in the digestion process plays a crucial part in the metabolism of lysine and fat, and helps maintain a healthy nitrogen balance. Moreover, these results may be related to antimicrobial activity of HR (Al-Marzoqi *et al.*, 2016).

Biochemical parameters:

Results of some serum biochemical traits due to feeding on diets supplemented with various concentrations of HR are shown in Table 4. No significant ($P \geq 0.05$) differences were detected in serum glucose, total protein, and creatinine as a result of feeding on diets supplemented with three levels of HR compared to the control diet. However, the diet contained 5 and 7.5 g HR/kg diet led to a significant decrease in serum albumin compared to the untreated-HR group, while all different levels of HR had significantly ($P \leq 0.05$) higher value of globulin than the control group, the opposite was true in respect of albumin/globulin ratio.

According to Melillo, (2007) the normal range of total protein, Albumin and Globulin in serum of rabbits are 5.4-7.5, 2.5-5 and 1.5-2.7 (g/dl) respectively, generally, this mean that the results are within the normal ranges. But, there is discrepancy between the current results and the findings of Al-Taee, (2013) who showed a significant increase in serum total protein concentration due to feeding on HR compared to control group.

Different dietary levels of HR as a feed supplementation did not appear to influence all studied serum differential which included cholesterol, HDL, LDL and vLDL (Table 4). However, the rabbits fed diet contained different levels of HR recorded insignificant (P≥0.05) decrease in both cholesterol and LDL as comparing with the control diet. Similar results were obtained by Yousef et al. (2014) who showed that HR seed oil significantly reduced LDL-c levels when compared to the control diet. The lipid profile may have improved as a result of consuming dietary HR by decreasing cholesterol production or -hydroxy -methylglutaryl-CoA reductase (the rate-limiting enzyme that mediates the initial step in cholesterol biosynthesis (Althnaian, 2014). The high copper content of HR seeds, which has blood cholesterol-lowering effects, may also be a factor in the hyperlipidemia characteristics of consuming HR seeds, according to (Mortazavi Moghaddam *et al.,* 2020). By lowering levels of total serum cholesterol and TG, HR seeds have been found to enhance blood lipids in studies (Chauhan et al., 2012; Korish and Arafah, 2013; Althnaian, 2014). Therefore, modifications in biochemistry and enzyme activity brought on by indicators of functions liver stress or decreased hepatic production of fatty acids may decrease lipid absorption while increasing their excretion (Chauhan et al., 2012).

Liver function and antioxidant capacity:

Generally, results in the present study clarified that the supplementation of HR to the rabbit's diets significantly (P≤0.05) increased the enzymes of liver (ALT and AST) with exception AST where no significant alternation as a result of fed diet contained 5 g HR/kg diet comparing with the control diet.

Regarding ALT and AST as indicator to liver function, the improvement in reproductive traits clarify that indicators of functions liver were undisturbed in all experimental groups in this study where, the normal range of ALT and AST in blood serum of rabbits are 45-80 and 35-130 (IU/L) respectively (Melillo, 2007). Thus, the values obtained are within the normal ranges of these enzymes in rabbits, these increases could not be considered an evidence for the presence of any serious damages to the liver. However, there is discrepancy between current results and the results of According to Abdella and Khalifah (2021), rabbits given oils and HR seed extracts had considerably lower blood ALT and AST concentrations than the control group. Additionally, according to the activity determination of serum ALT and AST compared to the control group, Yassmine *et al.* (2022) demonstrated that liver functions were unaffected in all experimental groups (base diet supplemented with HR seeds at levels 3, 4.5, and 6%, respectively).

It should be noted that both superoxide dismutase (SOD) and total antioxidant capacity (TAC) were significantly (P≤0.05) increased by feeding diets supplemented with 2.5, 5 and 7.5 g HR/kg diet especially level 5 g/kg diet compared to the control group.

In respect of serum antioxidants, under pregnancy and lactation oxidative stress can be viewed as an imbalance between prooxidants and antioxidants in the body of rabbits. This balance is maintained by the presence of natural antioxidants as present in HR seeds and antioxidant enzymes such as SOD. In fact, the biological body system exhibits a feeling of balance between the generation and neutralization of ROS; this equilibrium is sustained by the presence of natural antioxidants such TAC and SOD (Lubrano and Balzan 2015). This equilibrium, however, could become out of whack during pregnancy and lactation (Zeweil and El-Gindy, 2016).

Economic efficiency:

As shown in Table 6 the current study indicated that the highest net return was obtained from feeding on 5g HR/kg diet. While, the least net return was obtained from does fed the control diet followed by the does fed diet contained 7.5 g HR/kg. The current findings showed that both 5 and 2.5 g HR/kg diet mad a clear improvement in EF respectively as compared to the control group. In fact, this improvement in economic efficiency seems to be related to positively effects of feeding on diets supplemented with HR on the number of kits at weaning and FCR (Table 3).

CONCLUSION

According to the current results, it is concluded that dietary Habarachad supplementation up to 5 g/ kg diet for Black Balady rabbit's does could be used to maximize and improve reproductive and economic performance under conditions of the current study.

Table (1): Composition and calculated chemical analysis of the basal diet on dry matter basis

Ingredients	%
Barley grain	24.60
Alfalfa hay	31.00
Soy bean meal (44 %)	13.25
Wheat bran	28.00
Di-calcium phosphate	1.60
Limestone	0.95
Sodium chloride	0.30
Mineral-vitamin premix [1]	0.30
Total	100
Calculated analysis [2]	
Crude protein (%)	17.08
Digestible energy (Kcal / kg)	2416
Crude fiber (%)	12.55
Ether extract (%)	2.20
Calcium (%)	1.20
T. Phosphorus (%)	0.76
Lysine (%)	0.84
Methionine (%)	0.23
Lysine (%)	0.86
Price (LE/kg) [3]	4.68

(1) One kilogram of mineral–vitamin premix provided: Vitamin A, 150,000 UI; Vitamin E, 100 mg; Vitamin K3, 21mg; Vitamin B1, 10 mg; VitaminB2, 40mg; Vitamin B6, 15mg; Pantothenic acid, 100 mg; Vitamin B12, 0.1mg; Niacin, 200 mg; Folic acid, 10mg; Biotin, 0.5mg; Choline chloride, 5000 mg; Fe, 0.3mg; Mn, 600 mg; Cu, 50 mg; Co, 2 mg; Se, 1mg; and Zn, 450mg.

(2) Calculated analysis according to feed composition tables for rabbits feedstuffs used by De Blas and Wiseman (2010); (3) Price of one kg (Egyptian pound/Kg) for different ingredients: Barley grain, 4.6.; Alfalfa hay, 2.8.; Soy bean meal, 8.0.; Wheat bran, 2.1.; Di-calcium, 10.8; limestone, 0.20; Premix, 60.0; Sodium chloride, 0.50 and Kg of Habarachad, 40 (LE)

Table (2): Effect of dietary different levels of Habarachad on performance traits of rabbit does during gestation and suckling period.

Treatments / Traits	Habarachad (g/kg diet)				Pooled SEM	Sig.
	control	**2.5**	**5**	**7.5**		
Initial BW(g)[1]	3273	3192	3155	3168	72.19	NS
FI(kg/doe/140d)[2]	45.5^{a}	45.7^{a}	42.4^{c}	43.5^{b}	0.43	0.05
FI (g/doe/day)[3]	325.2^{a}	326.5^{a}	302.6^{c}	311.0^{b}	3.04	0.05

[1] = Initial body weight; [2] = Feed intake; [3] = Feed intake
a,b,c :Means in the same row bearing different superscripts are significantly different (p ≤ 0.05). NS= non- significant.

Table (3): Effect of dietary different levels of Habarachad on reproductive performance traits of Black Balady rabbits during three litters

Treatments / Traits	**Habarachad (g/kg diet)**				**Pooled SEM**	**Sig.**
	control	**2.5**	**5.0**	**7.5**		
Litter size(three litters) and traits of kids (from birth to 21d)						
Litter size at birth	9.0^{c}	15.0^{b}	22.7^{a}	8.7^{c}	1.72	0.05
Weight/kid at birth(g)	57.8^{bc}	61.6^{ab}	64.6^{a}	56.6^{c}	1.12	0.05
Number of kids at 21 d	7.7^{c}	13.3^{b}	19.0^{a}	7.7^{c}	1.44	0.05
Viability% at 21 d	85.1	88.9	83.8	88.4	1.41	NS
Weight/kid at 21 d	386.3^{a}	400.2^{a}	327.6^{b}	360.2^{ab}	11.09	0.05
Weight gain/d at 21 d	15.6^{a}	16.1^{a}	12.5^{b}	14.5^{ab}	0.55	0.05
Traits of kids (21-35 d and total period)						
Number of kids at 35 d	7.3^{c}	13.3^{b}	19.0^{a}	7.7^{c}	1.46	0.05
Viability% at 35 d	81.8	88.9	83.8	88.4	1.47	NS
Weight/kid at 35 d	710.0^{b}	756.2^{a}	706.8^{b}	695.8^{b}	4.17	0.05
Weight gain/d (21-35d)	23.1	25.4	27.1	24.0	0.89	NS
Total weight gain/kid/d	19.4^{b}	20.8^{a}	19.8^{b}	19.2^{b}	0.30	NS
Feed conversion ratio	8.8^{a}	4.5^{b}	3.2^{c}	8.2^{a}	0.72	0.05

a,b,c: Means in the same row bearing different superscripts are significantly different (P ≤ 0.05). NS= non- significant.

Table (4): Effect of dietary different levels of Habarachad on serum biochemical traits of Black Balady rabbits

Treatments / Traits	Habarachad (g/kg diet)				Pooled SEM	Sig.
	control	2.5	5.0	7.5		
Serum biochemical						
Glucose (mg/dl)	130.00	157.00	133.50	101.00	11.77	NS
Total protein(g/dl)	7.20	7.27	6.61	6.64	0.13	NS
Albumin(g/dl)	4.30^{a}	3.86^{ab}	3.39^{c}	3.53^{c}	0.13	0.05
Globulin(g/dl)	2.20^{b}	3.42^{a}	3.23^{a}	3.11^{a}	0.17	0.05
Albumin/Globulin	2.20^{a}	1.10^{b}	1.05^{b}	1.15^{b}	0.017	0.05
Creatinine (mg/d)	1.60	1.35	1.10	1.00	0.14	NS
Triglycerides(mg/dl)	69.00	75.50	76.00	92.00	4.62	NS
Cholesterol (mg/dl)	108.00	100.00	106.00	87.00	5.49	NS
HDL (mg/dl)[1]	45.50	45.00	47.50	40.00	1.38	NS
LDL (mg/dl)[2]	49.20	39.90	43.30	28.60	4.53	NS
vLDL(mg/dl)[3]	13.80	15.10	15.20	18.40	1.10	NS

[1]= High density lipoprotein; [2]= Low density lipoprotein; [3] = Very low density lipoprotein; a,b,c,d: Means in the same row bearing different superscripts are significantly different ($p \leq 0.05$). NS= non- significant

Table (5): Effect of dietary different levels of Habarachad on serum cholesterol and antioxidant capacity of Black Balady rabbits

Treatments / Traits	Habarachad (g/kg diet)				Pooled SEM	Sig.
	control	2.5	5.0	7.5		
Serum biochemical						
ALT (IU/L)[1]	35.00^{d}	43.00^{c}	52.50^{b}	60.00^{a}	3.46	0.05
AST (IU/L)[2]	27.00^{c}	42.50^{b}	42.00^{bc}	81.00^{a}	6.35	0.05
SOD (mM/L)[3]	0.29^{c}	$0.37a^{b}$	0.40^{a}	0.35^{b}	0.12	0.05
TAC (mM/L)[4]	0.18^{d}	0.21^{c}	0.31^{a}	0.29^{b}	0.16	0.05

1= Alanine transaminase; 2= Aspartate transaminase; 3 = Superoxide dismutase; 4 = Total antioxidant capacity; a,b,c,d: Means in the same row bearing different superscripts are significantly different ($p \leq 0.05$). NS= non- significant

Table (6): Effect of dietary different levels of Habarachad on economic efficiency of Black Balady rabbits

Treatments / Traits	Habarachad (g/kg diet)			
	control	**2.5**	**5.0**	**7.5**
Serum biochemical				
FI(kg/doe/140d)	45.5	45.7	42.4	43.5
Price/kg feed by EP[1]	4.68	4.78	4.88	4.98
Total feed cost	213.1	218.5	206.8	216.8
Number of kits at 35 d	7.3	13.3	19.0	7.7
Price at weaning	40	40	40	40
Total return (EP)	293.3	533.3	760.0	306.7
Net return (EP)	80.2	314.9	553.3	89.9
Economic efficiency[2]	37.6	144.2	267.7	41.5

[1]Price/ kg feed by EP= the price of one Kg feed by Egyptian pound and the price of one kg Habarachad 40 EGP; [2]Economic efficiency (%) = (Net return/Total feed cost) x 100

REFERENCES

Abdella, M. and Khalifah, A. 2021. Effects of oral administration of Lepidium sativum, Moringa oleifera oils and aqueous extract of Vitex agnnus castus on reproductive performance and blood biochemical of doe rabbits. Egypt J. Rabbit Sci. 31: 1–24.

Al-Marzoqi, A.H., Al-khafaji, N.M.S. and Hussein, H.J. 2016. *In vitro* antimicrobial activity assessment of the crude phenolic, alkaloid and terpenoid compounds extracts of lipidium sativum L. on human pathogenic bacteria. Int. j Chemtec Res, 9: 529-532.

Al-Taee, N. 2013. Effect of seeds extraction of *lepidium sativum* on zinc and iron elements and some biochemical parameters in serum of white male rabbits Euphrates. J. Agric. Sci, 5:23-35.

Althnaian, T. 2014. Infuence of dietary supplementation of garden cress (*Lepidium sativum L.*) on liver histopathology and serum biochemistry in rats fed high cholesterol diet. J. Adv. Vet. Anim. Res. 1, 216–223.

Asl, F. R., Khosravi, M., Hajikhani, R., Solati, J. and Fahimi, H. 2021. Complementary efects of coenzyme Q10 and Lepidium sativum supplementation on the reproductive function of mice: An experimental study. Int. J. Reprod. Biomed. 19: 607-618.

Azene, M., Habte, K. and Tkuwab, H. 2022. Nutritional, health benefits and toxicity of underutilized garden cress seeds and its functional food products: a review. F. Prod. Proc. and Nut, 4(33): 1-13.

Beauchamp, C. and Fridovich, I. 1971. Superoxide dismutase: improved assays and an assay applicable to acrylamide gels. Anal Biochem. 44:276–287.

Berehe, S. G. and Boru, A. D. 2014. Phytochemical screening and antimicro bial activities of crude extract of Lepidium sativium seeds grown in Ethiopia. Inter. J. Pharma. Sci. and Res, 5(10): 4182–4187.

Chauhan, K., Sharma, S., Agarwal, N., Chauhan, S. and Chauhan, B. A 2012. Study on potential hypoglycemic and hypolipidemic efects of *Lepidium sativum* (Garden Cress) in Alloxan induced diabetic rats. Am. J. Pharm. Tech. Res. 2, 522–535.

Chatoui, H., Tabaaoui, A., Aneb, M., Bakri, B., Harhar, H. and Tabyaoui, M. 2016. Phytochemical screening antioxidant and antimicrobial activity of *lepidium sativum* seeds from morocco. J. Mater. Environ. Sci, 7(8): 2938-2946.

De Blas, J. C. and Wiseman, J. 2010. 'Nutrition of the Rabbit' CABI Publishing (2nd Revised edition) Wallingford, Oxford, Uk.

Deshmukh, Y. R., Thorat, S. S. and Mhalaskar, S. R. 2017. Infuence of garden cress seed (*Lepidium sativum L.*) bran on quality characteristics of cookies. Inter. J. Cur. Microbiol. and Appl. Sci, 6(9): 586–593.

Doke, S. and M. Guha 2014. Garden cress (Lepidiumsativum L.) seed - an important medicinal source: a review. J. Nat. Prod. Plant Reso, 4 (1): 69-80.

Duh, P. and Yen, G. 1997. Antioxidative activity of three herbal water extracts. Food Chemistry 60 (4): 639-645.

Duncan, D.B. 1955. Multiple ranges and multiple f- test, Biometries 11: 1-42.

El-Salam, A., Kholoud, H. Toliba, A. El-Shourbagy, G.A. and El-Nemr, S.E. 2019. Chemical and functional properties of garden cress (Lepidium sativum L.) seeds powder. Zag. J. Agri. Res, 46: 1517-1528.

El-Speiy, M., Abdella, M., Abd Elaal, M. and Khalifah, A. 2021. Effects of oral administration of *Lipidium sativum*, *Moringa oleifera* oils and aqueous extract of *Vitex agnus-castus* on reproductive performance and blood biochemical of doe rabbits. EJRS, 31:(1-42).

FEDNA, 2013. Nutritional guidelines for feeding pet rabbits. European Pet Food industry federation/ Av. Louse 89/ B-Bruxells/ www.fediar.org.

Gokavi, S.S., Malleshi, N.G., and Guo, M. 2004. Chemical composition of garden cress (*Lepidium sativum*) seeds and its fractions and use of bran as a functional ingredient. Plant Foods Hum. Nutr. 59: 105-111.

Hekmatshoar, Y., Ozkan, T., Saadat, Y.R., and Saadat, Y.R. 2021. Evidence for health-promoting properties of *Lepidium sativum L.*: an updated comprehensive review.Turk J. Phrm. Sci, 19(6):714-723.

Henry, R.J. 1964. Clinical Chemistry, Principles and Technics; Harper and Row: New York, NY, USA.

Hunter, D., Borelli, T., Beltrame, D. M., Oliveira, C. N., Coradin, L., Wasike, V. W. Tartanac, F. 2019. The potential of neglected and underutilized species for improving diets and nutrition. Planta, 250(3): 709–729. https://doi.org/10.1007/s00425-019-03169-4

Imade, O. V., Smith, O. F. and Gazal, O. S. 2018. Effects of dietary inclusion of *Lepidium sativum* (garden cress) seed on plasma luteinizing hormone and reproductive performance in female rabbits. J. Afr. Assoc. Physiol. Sci. 6: 79–84.

Koracevic, D.; Koracevic, G.; Djordjevic, V.; Andrejevic, S.; Cosic, V. 2001. Method for the measurement of antioxidant activity in human fluids. J. Clin. Pathol, 54: 356–361.

Korish, A. A. and Arafah, M. M. 2013. Camel milk ameliorates steatohepatitis, insulin resistance and lipid peroxidation in experimental non-alcoholic fatty liver disease. BMC Complement Altern. Med. Biomed. Central, 13: 1–12.

Labbé, D., Vassault, A., Cherruau,B., Baltassat,P., Bonète, R., Carroger, G., Costantini, A., Guérin, S., Houot, O. Lacour, B., Nicolas, A., Thioulouse, E. and Trépo, D. 1996. Method selected for the determination of creatinine in plasma or serum. Choice of optimal conditions of measurement. Ann. Biol. Clin. 54(8-9):285-298.

Lahiri, B. and Rani. R. 2020. Garden cress seeds: chemistry, medicinal properties, application in dairy and food industry: A Review. Emergent Life Sci. Res, 6: 1-4.

Lubrano, V. and Balzan, S. 2015. Enzymatic antioxidant system in vascular infammation and coronary artery disease. World J. Exp. Med. 5: 218.

Mahrose, K.M., Abd El-Monem, U. and Peris, S. 2010. Effects of photoperiod and mating or semen collection times on the performance of does and bucks of New Zealand white rabbits under hot climatic conditions of Egypt. In Proceedings of the 6th International Conference on Rabbit Production in Hot Climates, Assuit, Egypt, 1–4 February; 2010, pp. 503–520.

McGowan, M.W., Artiss, J.D., Strandbergh, D.R. and Zak, B. A. 1983. peroxidase-coupled method for the colorimetric determination of serum triglycerides. Clin. Chem. 29: 538–542.

Mehmood, M. H., Alkharfy, K. M., and Gilani, A. H. 2011. Prokinetic and laxative activ ities of *Lepidium sativum* seed extract with species and tissue selective gut stimulatory actions. J. Ethnopharm, 134(3): 878–883.

Melillo, M. 2007. Rabbit Clinical Pathology. J. Exo. Pet Med, 16(3): 135-145.

Mellor, S. 2000. Antibiotics are not the only growth promoters. Wor. Poult. 16:14–15.

Mortazavi Moghaddam, S.G., Kianmehr, M., and Khazdair, M.R. 2020. The possible therapeutic effects of some medicinal plants for chronic cough in children. Evid. Based Complement Altern. Med,1-15.

Oseni, S.O. and Lukefahr, S.D. 2014. Rabbit production in low-input systems in africa: situation, knowledge and perspectives – a review. World Rabbit Sci, 22: 147-160.

Pascual, J. J., Savietto, D., Cervera, C. and Baselga, M. 2013. Resources allocation in reproductive rabbit does: A review of feeding and genetic strategies for suitable performance. World Rabbit Sci. 21: 123–144.

Patil, D. D., Lal, Er. A. and Nandkule, V. D. 2015. Development and quality evaluation of garden cress seed biscuits. Inter. J. Sci., Eng. Technol., 2(3): 770-774.

Peters, T. 1968. Determination of total protein in serum. Clinical Chemistry, 14:1147.

Qusti, S., El Rabey, H. A., and Balashram, S. A. 2016. The hypoglycemic and anti-oxidant activity of cress seed and cinnamon on Streptozotocin induced diabetes in male rats. Evid. Based Complement Altern. Med, 1–15.

Reitman, S. and Frankel, S. 1957. A colorimetric method for the determination of serum glutamic oxalacetic and glutamic pyruvic transaminases. Am. J. Clin. Pathol., 28: 56–63.

Sethiya, N.K., Trivedi, A. and Mishra. S. 2014.The total antioxidant content and radical scavenging investigation on 17 phytochemical from dietary plant sources used globally as functional food. Biomed and Prev, Nutri, 4: 439-444.

Singh, C. S., Paswan, V. K. and Naik, B. 2015. Exploring potential of fortifca tion by garden cress (Lepidium sativum L.) seeds for development of functional foods—A review. Ind. J. Nat. Prod. and Reso, 6(3): 167–175.

Speake, B.K.; Murray, A.M.B. and Noble, R.C. 1998. Transport and transformation of yolk lipids during development of the avian embryo. Progress in Lipid Res., 37: 1-32.

SPSS. 2008. SPSS User´s Guide Statistics. Ver. 17. Copyright SPSS Inc., USA.

Surai, P.F. 1999a. Vitamin E in avian reproduction. Poult. Avi. Biolo, Review, 10: 1-60.

Tietz, N.W. and Berger, S. 1976. Fundamentals of Clinical Chemistry; Saunders W.B.: Philadelphia, PA, USA.

Victoria, I. O., Fedrick, S. O., Oladele, G., Oluwafemi, A. E. and Atiang, B. J. 2020. Effects of *Lepidium sativum* seed on reproductive characteristics in rabbit bucks. J. Phytopharm. 9: 89–95.

Villamide M.J; Maertens, L.; and De Blas, J. C. 2010. Feed evaluation. In: The Nutrition of the Rabbit. (Eds. De Blas J. C. and Wiseman J.), 2nd Ed. CABI, Wallingford, pp. 151-162.

Warnick, G.R. and Wood, P.D.1995. National cholesterol education program recommendations for measurement of high-density lipoprotein cholesterol: Executive summary. The national cholesterol education program working group on lipoprotein measurement. Clin. Chem, 41: 1427–1433.

Weydert, C.J. and Cullen, J.J. 2010. Measurement of superoxide dismutase, Catalase, and glutathione peroxidase in culture cells and tissue. Nat. Protoc. 5(1): 51-66.

Yassmine, M. El-G., Soliman, M. Z., , Mohamed, H.A., Azza, Y. I., Safaa, H.A. and Sabrin, A. M. 2022. Reproductive performance and milk yield of rabbits fed diets supplemented with garden cress (*Lepidium sativum*) seed. Scientific Reports, 12 Article number: 17083.

Youssef, G.M., El-Ghamery H.E. and El-Sawy, H.A. 2014. Study the physico-chemical properties and antihyperlipidemic activities of garden cress seed oil. J Am Sci, 10(12):324–330.

Zeweil, H. S. and El-Gindy, Y. M. 2016. Pomegranate peel as a natural antioxidant enhanced reproductive performance and milk yield of female rabbits. World Rabbit Sci. 24: 207–212.

الملخص العربي

تأثير تغذية امهات الارانب علي علائق مضاف اليها بذور حب الرشاد علي الاداء التناسلي والإقتصادي

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يهدف تصميم الدراسة الحالية الي بحث تأثير حب الرشاد (رشاد الحديقة) كإضافة الي العليقة علي الأداء التناسلي والإقتصادي للارانب المحلية في مصر. تم تقسيم الارانب الي أربعة مجاميع متساوية ، وتحتوي كل مجموعة علي ثلاثة اناث وذكر. تم تغذية ارانب مجموعة المقارنة علي العليقة الأساسية فقط ، بينما تم اعطاء ارانب باقي المجاميع التجريبية العليقة الاساسية مضافاً اليها 2.5 ، 5 و 7.5جم بذور حب الرشاد/ كجم عليقة علي التوالي. سجلت الارانب المغذاه علي عليقة مضاف اليها 2.5 و 5جم /كجم عليقة أقل استهلاكا للعلف بدرجة معنوية مقارنة بمجموعة المقارنة. تحسن حجم البطن عند الولادة معنويا نتيجة التغذية علي عليقة مضاف اليها 5جم /كجم عليقة يليها في التحسن العليقة المضاف اليها 2.5جم /كجم عليقة مقارنة بالعليقة المفارنة. وجد ان نتاج الارانب من الامهات المغذاة علي عليقة مضاف اليها 5جم من حب الرشاد /كجم عليقة سجلت الوزن الاعلي معنويا عند الولادة وكذلك العدد عند 21 يوم متبوعة بالمستوي الاقل من مقارنة بالمجموعة الغير معاملة. ذاد حجم البطن عند الفطام (35 يوم) معنويا بالتغذية علي عليقة مضاف اليها 5جم /كجم عليقة ويليها تلك المضاف اليها 2.5جم حب الرشاد /كجم عليقة مقارنة بالعليقة المقارنة. وجد تحسن معنوي في معدل التحويل العذائي نتيجة التغذية علي العليقة المضاف اليها 5 و 2.5 جم /كجم عليقة. سجلت المستويا ت المختلفة من الاضافة اعلي قيمة لجلوبيولين السيرم مقارنة بالكنترول. أيضا ادت المستويات المختلفة من حب الرشاد الي انخفاض غير معنوي في مستوي الليبوبروتين منخفض الكثافة مقارنة بالعليقة المقارنة. من ناحية اخري يجب ملاحظة ان كل من السوبر اوكسيد ديسميوتيز و مضادات الاكسدة الكلية ارتفعت معنويا نتيجة التغذية علي 2.5 و5 و7.5 جم / كجم عليقة وخاصة 5جم /كجم عليقة مقارنة بالعليقة المقارنة.

بناءاً علي تلك النتائج ، يمكن ان نستنتج ان اضافة حب الرشاد لعلائق امهات البلدي الاسود حتي مستوي 5جم /كجم عليقة يمكن ان يستخدم لتحسين وتعظيم الاداء التناسلي والإقتصادي تحت ظروف التجربة الحالية.